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ISGAN
INTERNATIONAL SMART GRID ACTION NETWORK

International Energy Agency (IEA)
Technology Collaboration Programme (TCP) CEM
International Smart Grid Action Network (ISGAN)

Annual Report 2022

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Technology Collaboration Programme
by iea

Disclaimer

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August 2023

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1. Letter from the Chair

I am extremely pleased and honoured to introduce you to the twelfth Annual Report of ISGAN, the International Smart Grid Action Network.

ISGAN is a renowned global platform, organized as both a Clean Energy Ministerial (CEM) initiative and an International Energy Agency (IEA) Technology Collaboration Programme (TCP), that aims at promoting innovative strategies and solutions for the deployment of smart electricity grids worldwide, thus supporting its members' efforts in transitioning to greener, smarter, more reliable, and resilient decarbonized and affordable power systems.

With its strong emphasis on collaboration, ISGAN brings together countries from five continents spanning both developed and emerging economies. This diverse membership creates a truly cooperative environment, with members willing to share knowledge, strategies, and best practices to inform policymakers at regional, national, and international level.

Throughout 2022, ISGAN achieved significant milestones and successful accomplishments and I would like to thank all members for their support and strong commitment to advance ISGAN activities, including thorough series of meetings, webinars, and workshops, as well as Working Groups' technical reports and policy briefs.

I would like to recall the two fruitful Executive Committee (ExCo) 2022 meetings, that promoted a highly dynamic and active participation from nearly all ISGAN ExCo members. In particular, the 23rd ISGAN ExCo meeting, that has been virtually held due to Covid-19 Pandemic, and the 24th ISGAN ExCo meeting, hosted by Australia, that was the first in-presence meeting after over two years of travel restrictions and took place back-to-back to the IRED 2022 Conference in Adelaide (South Australia). The regained personal interaction was particularly appreciated and allowed a very close exchange among ExCo members, Working Group Managers, and national experts.

ISGAN made also important progress in formalizing an effective collaboration with the Green Powered Future Mission (GPFM) of Mission Innovation. I would like to mention the two successful ISGAN-GPFM joint side events held at the Annual Gathering in April 2022 in New Delhi and at CEM13/MI-7, also known as Global Clean Energy Action Forum (GCEAF), in September 2022 in Pittsburgh (US). It is worth to highlight the signature at GCEAF of the ISGAN-GPFM Memorandum of Understanding, to formalize the collaboration between these two initiatives, as well as to identify the main synergies and impact areas.

Besides strengthening the fruitful collaboration with the GPFM, ISGAN continued the collaboration with the Global Smart Energy Federation (GSEF), as well as with other global partners, such as the CEM's 21st Century Power Partnership (21CPP) and the IEA Digital Demand-Driven Electricity Networks (3DEN), thus further enhancing ISGAN's international outreach.

I believe that, despite the large number of global initiatives focusing on the power sector, ISGAN remains an extremely useful and needed international platform, which continues to drive advancements in smart grid development and future deployment across the globe.

This Annual Report summarizes important ISGAN milestones and tangible deliverables achieved in 2022, further promoting ISGAN's engagement beyond member countries, thus involving also relevant grid stakeholders and experts in the field of smart electricity grids.

It is worth to also mention the successful accomplishment of the internal restructuring process which led to the transition from the nine former Annexes to the existing six Working Groups, making ISGAN more agile and better fit for all communications, capacity building and knowledge sharing tasks.

It is a real honour for me to serve as ISGAN Chair and I would like to express my sincere gratefulness to the whole ISGAN community; my special thanks go to the Vice-Chairs and Presidium members, all ExCo members, the Co-Secretariats, Working Groups Managers, Technical Leads, and national experts, who have been all crucial to ISGAN's success.

I would like to conclude my message by wishing that this report could inspire you to engage with the ISGAN community, thus contributing global endeavour towards advancement of clean energy worldwide through smart grids.

Yours sincerely,

Luciano Martini

2. International Smart Grid Action Network

2.1. Summary

The International Smart Grid Action Network (ISGAN) strives for the accelerated development and deployment around the world of smarter, cleaner, and more flexible electricity grids—as in "smart grids". ISGAN provides a platform and channel for cooperative activities and exchange of smart energy-related knowledge, trends, lessons learned, best practices, and future plans in support of national, regional, and global climate and clean energy objectives. ISGAN's national experts come from its 26 participating countries and the European Commission, as well as other stakeholders, and include engineers, analysts, academics, industry executives, government officials, project managers, policymakers, technology providers, and utility planners.

2.2. ISGAN structure

ISGAN is both a Clean Energy Ministerial (CEM) initiative and an International Energy Agency (IEA) Technology Collaboration Programme (TCP). It reports to both bodies but operates formally under a framework of the IEA. In contrast to most CEM workstreams, ISGAN is organized under a legally binding Implementing Agreement (IA), with each of its "Contracting Parties" (official Participants that are signatories to the IA) represented on an Executive Committee (ExCo) responsible for ISGAN's management and oversight. The ISGAN ExCo meets at least twice annually.

ISGAN is supported by two Secretariats: the Austrian Institute of Technology (AIT), which is focused on ISGAN's IEA related activities, and the Korea Smart Grid Institute (KSGI), which is focused on activities concerning CEM. ISGAN maintains a common fund, which is supported by annual dues from its Contracting Parties for certain functions such as the ISGAN website and the co-Secretariats. Nonetheless, ISGAN activities are largely task-shared among its Participants.

ISGAN's organizational structure in 2022

2.2.1. The Presidium

The ExCo is led by the Chair and two Vice-Chairs and together they form the Presidium. Each member of the Presidium is elected for a period of two years, with possible re-election. The first Presidium was elected at the inaugural meeting in Seoul, Korea, in June 2011. Owing to the complexity of ISGAN's activities, having two Vice-Chairs was deemed appropriate. The Presidium in 2022 consisted of:

Luciano Martini
Chair of ISGAN
Ricerca sul Sistema Energetico S.p.A, Italy
Luciano.Martini@rse-web.it

Russell Conklin
ISGAN Vice Chair
U.S. Department of Energy
Russell.Conklin@hq.doe.gov

Arun Kumar Mishra
ISGAN Vice Chair
Director NSGM-PMU, India
akmishra@powergridindia.com

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2.2.2. Operating Agent and Secretariat

As per the Implementing Agreement, an Operating Agent (OA) must be appointed as a legal representative of ISGAN. AIT Austrian Institute of Technology has been holding the position of ISGAN OA since June 2017.

Mihai Calin is the Operating Agent of ISGAN, Mihai.Calin@ait.ac.at

ISGAN is supported by two co-Secretariats, as per the decision taken at ExCo13: AIT Austrian Institute of Technology and the Korea Smart Grid Institute (KSGI). The Co-Secretariat at AIT is responsible for the management of ISGAN, communication matters as well as the management of the common fund, and reporting to the IEA:

Head of the Secretariat: **Susanne Windischberger,** Susanne.Windischberger@ait.ac.at; ISGAN@ait.ac.at

The Co-Secretariat at KSGI is responsible for the support of ISGAN contributions to the Clean Energy Ministerial, the ISGAN Award of Excellence, and coordination and contact activities within Asia:

- **Chloe Yoon**, ysj@smartgrid.or.kr

- **Sky Son,** jcson@smartgrid.or.kr

Since November 2022 Secretariat at KSGI is supported by Korea Power System Exchange (KPX), who share the responsibility for the outreach to Asian countries.

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ISGAN Executive Committee and Working Group Managers.

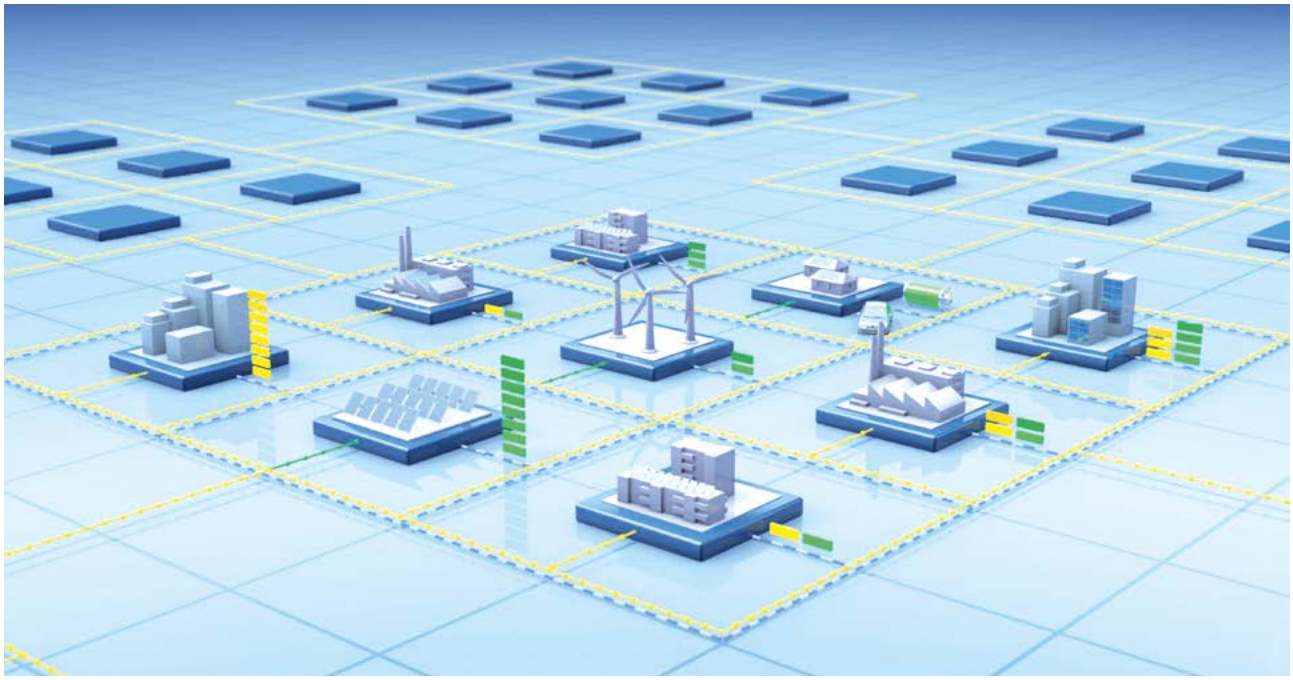
2.3. ISGAN Member Countries

ISGAN's worldwide presence

1.	Australia	14.	Japan
2.	Austria	15.	Korea
3.	Belgium	16.	Mexico (inactive)
4.	Canada	17.	Norway
5.	China	18.	Singapore
6.	Denmark	19.	South Africa
7.	Finland	20.	Spain
8.	France	21.	Sweden
9.	Germany	22.	Switzerland
10.	India	23.	The European Commission
11.	Ireland	24.	The Netherlands
12.	Israel	25.	United Kingdom
13.	Italy	26.	United States of America

2.4. What is a Smart Grid?

Although the definition and parameters can vary among countries, a "smart grid" is essentially defined as an electricity network that uses digital and other advanced technologies to monitor and manage the transport of electricity from all generation sources to meet the varying electricity demands of all end users. Smart grids coordinate the needs and capabilities of all generators, grid operators, end users, and electricity market stakeholders to operate all parts of the system as efficiently as possible, minimizing costs and environmental impacts while maximizing system reliability, resilience, flexibility, and stability *(adapted from iea.org)*.



Schematic view of a modern electricity grid: Smart Grid

2.5. Driver and Trends

ISGAN has identified several intersecting and ever-evolving trends for electricity systems globally:

- Increasing links between energy security and climate security,
- Growing emphasis on a more people-centered energy transition, including wider energy access and other benefits,
- Greater systems integration, resilience, and flexibility (versus traditional technology stovepipes),
- Ubiquitous digitalization, and related operational and security needs; and
- Electrification of additional energy uses such as transport and building heat to make a net-zero carbon economy possible.

These trends are driving fundamental changes to the bedrock assumptions that have undergirded power system development and operation for over a century. As a result of these trends, the lexicon used to describe grids and grid actors needs to be updated to reflect a more flexible and dynamic operational environment with two-way flow of energy and increased attention to Energy-as-a-Service.

2.6. Operational Priorities and Organization

ISGAN activities seek to:

- Build a stronger global understanding of the value, impacts, and modalities of smart grids development, deployment, and operation;
- Draw attention to emerging solutions and address gaps in knowledge and tools;
- Improve peer-to-peer exchange, foster cooperative activities and technical assistance; and
- Recognize excellence in projects and approaches with the objective to support their adaptation in other markets.

ISGAN is especially focused on clarifying and promoting specific aspects of smart grids where governments have policy or regulatory authority, expertise, convening power, or other leverage. With rare exceptions, ISGAN's work does not entail direct technology development or deployment activities that fall under other forums, such as Mission Innovation's Green Powered Future Mission.

In recent years, key themes for ISGAN's work have been flexibility, digitalization, interoperability, and resilience.

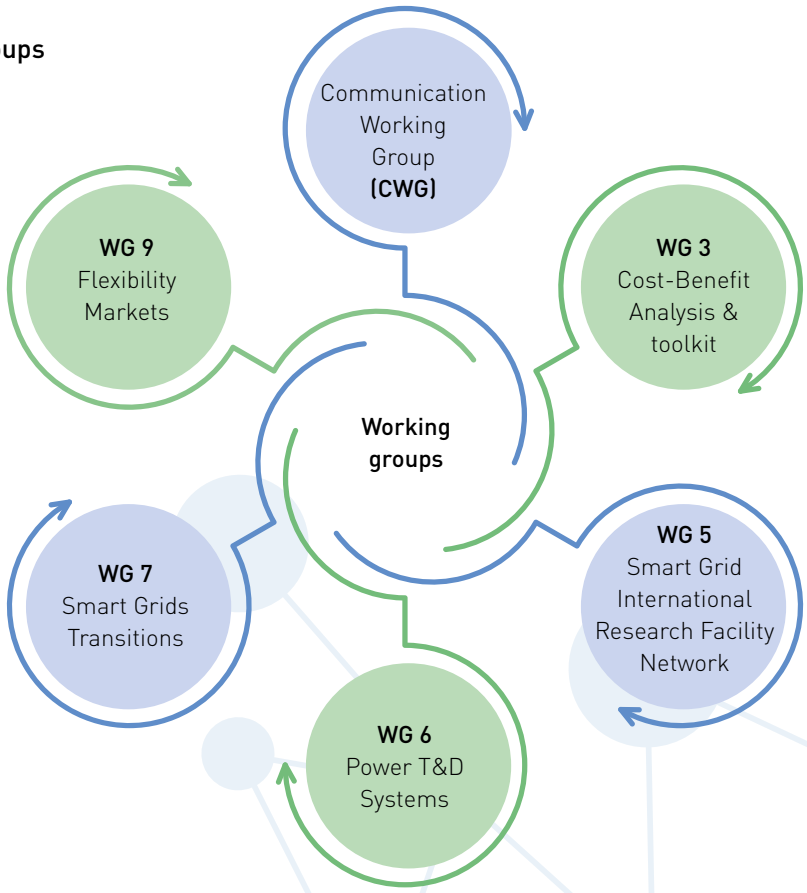
ISGAN organizes its activities under standing Working Groups, each operating under its own manager and with its own set of experts and other participants, as well as ExCo-driven workstreams. Currently, ISGAN has six Working Groups:

- Communications Working Group
- WG3: Benefit and Cost Analyses
- WG5: Smart Grid International Research Facility Network
- WG6: Power T&D Systems
- WG7: Smart Grid Transitions
- WG9: Flexibility Markets – Development and Implementation

ISGAN has one ongoing ExCo-driven workstream:

- ISGAN Award of Excellence

ISGAN Working Groups



3. ISGAN Highlights in 2022

3.1. IEA and ISGAN Workshop on Flexibility for Resilience in Integrated Systems

Paris, 3-4 October at IEA Headquarter

ISGAN's Working Group 6 on Power Transmission and Distribution Systems focused in 2022 on the topic of Flexibility for Resilience. Together with the European Technology and Innovation Platform on Smart Networks for Energy Transition (ETIP-SNET), The Working Group published a report "Flexibility for Resilience" (2022-ISGAN-WG6_Flexibility-for-Resilience.pdf(iea-isgan.org)). While this report covers mainly the technological view of this very important topic, the group also wanted to disseminate the information on a policy level and with emerging economies and developing countries.

With a similar focus, ISGAN and IEA's Digital Demand-Driven Electricity Networks (3DEN) Initiative co-organized an international high-level expert workshop "Flexibility for resilience in integrated systems" to enhance international collaboration and research, share best practices, and provide policy guidance on deploying flexibility for resilience. Through the collaboration with IEA, a particular focus was on emerging economies. Because emerging economies are typically the most affected by severe events, there is an opportunity to include resilience while still expanding and developing their power systems in line with growing electricity demand. The workshop featured interventions by IEA, ISGAN, the Norwegian University of Science and Technology NTNU, the Research Institute of Sweden RISE, ENTSO-E, ETIP SNET, the Austrian Institute of Technology AIT, regulatory agencies, think tanks, and other organizations working on this topic. The workshop provided input to advance key policy messages related to the nexus of flexibility, resilience, and digitalization. It also identified synergies and possibilities for future international collaboration, including through IEA, ISGAN, and interested partners.

The Workshop included the following items:

- Discussing the societal transformation towards the situation where a new generation of stakeholders provides power flexibility services for the grid, as well as on the importance of energy policy and regulation in this transformation. This discussion was based on the findings of the 2022 ISGAN WG6/ETIP-SNET white paper "How can flexibility support resilience?"
- Sharing and discussing in-group works, best practices and innovative approaches for leveraging active demand side flexibility.
- Developing key policy messages related to flexibility, resilience and digitalization, as the objective of the workshop.
- Addressing synergies and possibilities for future international collaboration, including through IEA and ISGAN and interested partners.

IEA and ISGAN workshop on 'Flexibility for resilience in integrated systems'

3.2. Highlight: Knowledge Sharing Project: Network Planning under Uncertainty

This knowledge exchange project addressed a theme of which the solution can help enable or facilitate the implementation of smart grid projects: grid planning and decision-making under uncertainty. It explored how best to develop power grids that contribute to global sustainable development goals, despite the fact that much of the data on current grids is insufficient.

The planning processes that guide the development of electricity networks are complex and involve interaction between a large number of stakeholders at different levels. Decision-making is guided both by high-level policies focused on socio-economic objectives as well as by more technical regulations and performance indicators. Given the urgency of the energy transition towards fully renewable energy systems, it is crucial that these planning and decision-making processes are efficient, transparent and based on sound principles and governance mechanisms.

In preparation for the workshop series, data on the current situation of network planning was collected in the participating countries. This data included inputs on (1) the planning process, (2) governance mechanisms and the applicable regulatory framework, as well as on (3) the status of uncertainty and (4) the general perception of the theme among the stakeholders involved. Finally, an outlook on future developments was collected. Inputs were provided by Austria, Belgium, Canada, India, Italy, the Netherlands, Norway, South Korea, Spain, Sweden and the UK. The geographical spread of the project participants was very beneficial, as different aspects regarding network development, political strategy and applicable regulation were provided.

Planning processes are complex and differ from country to country and from voltage level to voltage level. In general, they include various aspects such as grid studies, the development of future scenarios, and sometimes market studies that traditionally define the need for grid-based solutions. The process is determined by the grid operator's responsibilities within the framework of objectives and constraints.

Traditionally, the planning process has been driven by TSO responsibilities, which are: security, adequacy, quality of service, resilience and efficiency. However, these TSO responsibilities have shifted towards including decarbonization and more recently towards including energy security and affordability for customers. The planning processes are therefore assessed on a technical, economic, but also on a social and environmental level, all levels from which projects are prioritized. These projects go through a process of consultation, approval, procurement, and implementation.

According to many interviewees, this process needs to be updated, in order to make multi-level decisions using a scenario-based approach that allows to quantify the impact of uncertainties and to balance risks and benefits. Finding robust and flexible solutions that can be applied to different scenarios is a major challenge.

The main challenges were related to the following aspects:

- Updating parameters that take into account increased complexity and uncertainty, e.g.
  - Changing system conditions
  - Assumptions on load and generation (changing demand, high generation from renewables)
  - New network aspects (new load types, mutual interaction of new HVDC systems, etc.)
  - Forecasts (winter peak may no longer be the most stressful system condition, wind generation assumptions, uncertainties in national renewable deployment targets, long-term forecasts that depend on technologies that have yet to be developed, etc.)

  - Price developments (e.g. prices of key commodities)
  - Consideration of heterogeneous connection requests of new renewable power plants
- Use of advanced methods
  - New tools to incorporate opportunities arising from non-asset (market-based) solutions, such as storage and other local flexibility resources.
  - Uncertainty modelling , e.g. regarding the availability of flexibility resources, related to the realisation of the planned loads
  - Improved analytical capacities (e.g. electronically controlled nature requires updating grid codes and improving analytical capacities for grid stability studies)
  - Use of probabilistic approaches (instead of deterministic approaches) to model the uncertainty of generation and demand profiles
  - New methods for assessing the stability of the electrical system as inertia decreases and inverter-based systems become more prevalent
- Expansion of granularity in time and space
  - Consideration of heterogeneous locations for renewable power plants
  - Adjusting lead times for grid users with shorter lead times, such as solar farms or certain industries
  - Avoiding interconnection backlogs in the current planning framework, e.g. for offshore infrastructures

Most of the workshop took place in 2022, but the final in-person workshop took place during the 25th meeting of the Executive Committee of ISGAN in March 2023 in Berlin, Germany.

The final result of the knowledge sharing project with policy recommendations, will be published during a ISGAN-GPFM side event at the 14th Clean Energy Ministerial in July 2023 in Goa, India.

4. ISGAN Working Groups

The work in ISGAN is organized in six standing working groups. In the following there is a short description of each Working Group and of the highlights of their achievements:

4.1. Communication Working Group

The ISGAN Communication Working Group (CWG) helps to collect, summarize, and disseminate information related to the diverse actions of the TCP. Internally, the CWG is a cross-cutting group that collaborates with other ISGAN working groups on various communication activities. The CWG helps draft, edit, and revise casebooks, surveys, and policy documents. Through these activities, CWG facilitates exchanges between ISGAN members and works to identify overlaps and synergies between them. The CWG also has an important role in dissemination and outreach. Just as implementing smart grids, technologies, and systems require the engagement of multiple stakeholders—policy makers, governing bodies, TSOs, DSOs, and NGOs—the CWG creates and publishes policy-focused and public-facing materials that share knowledge, identify trends, and anticipate future developments. These documents, videos, workshops, webinars, and other content are designed to reach various discourse communities and support national, regional, and global clean energy objectives.

Main Highlights from 2022

In 2022, a casebook was published on Microgrid Value Propositions. This casebook focuses on microgrids that are commercially viable. It seeks to understand the technologies, business models, scale, and vendor landscape. Five cases from four ISGAN countries were collected and described.

A Knowledge Sharing Project Network Planning and Decision-Making under Uncertainty started in 2022 and was finalized in June 2023. (details about this project are in Section 3.2). With significant support from WG 6: Power T&D Systems, the project began with online meetings in 2022 to review the complex,

multifaceted, and challenging task of developing network infrastructure as an enabler of low-carbon electricity. Further workshops identified root causes for the identified challenges formulated solutions.
The task on Virtual Learning hosted webinars within the ISGAN Academy, covered topics such as the enhancement of smart grid standards, real-time cross-border flexibility markets, sustainable peak load transformers, TSO-DSO coordination activities, and harmonized European flexibilities markets. Overall, the CWG hosted eight online events each with several hundreds of participants from countries around the world. A detailed list of webinars and their topics can be found in section ISGAN Virtual Learning Webinars 2022.

Other Activities

Other activities of the CWG include the promotion of materials for the Clean Energy Ministerial CEM 13 and the renewal of texts on the ISGAN Website, as well as posting news on the LinkedIn page of ISGAN.

4.2. WG3: Benefit and Cost Analyses

ISGAN WG3, which covers cost-benefit analysis and toolkits, aims to create tools that analysts, regulators, utilities, and stakeholders of the electrical system can use to determine the requirements and priorities for investing in smart grid systems and regulatory changes. The outcomes can be used to develop customized business cases, considering the existing regulatory and market structures, the system's current status, the available resources and generation assets, as well as the demand profiles. In the analysis, various factors (including the political and regulatory context) that can influence the decision to choose or limit certain benefits and costs will be considered.
Since it is expected that different ISGAN countries will prioritize particular domains within the power sector in developing methodological frameworks and tools, a more broad definition of smart grid will be used. Thus, the full range of technologies and activities, from centralized power generation through transmission and distribution networks to end uses and dis-

tributed generation, including the interfaces between specific domains, will be encompassed.
Also, WG3 aims to develop a global framework and related analyses that can identify, define, and quantify in a standardized way the benefits that can be realized from the demonstration and deployment of smart grids technologies and practices in an electricity system. The existing knowledge and experience gained in different participating countries, as well as current international efforts underway and cooperation among major smart grids stakeholders globally, provide a strong foundation for the analysis performed by the WG.

The last product of WG3 is the smart grid evaluation toolkit (also known as smartgrideval), a web-based software that provides a novel decision-making support tool for strategical smart distribution system planning based on joint Multi-Criteria-Analysis and Cost Benefit Analysis (MCA-CBA).

Main Highlights from 2022

New studies with MCA-CBA tool integrating sector coupling

In the coming decades, the energy system needs to change dramatically to accomplish the transition to a decarbonised energy system. This transition is necessary to achieve the EU and UN 2050 targets, which aim to decarbonise the energy sector, make buildings more energy-efficient, increase cleaner forms of transport, and support greater sustainability in industry, among other objectives. To achieve the energy transition goals, intertwining different vectors (e.g., electricity, gas and thermal), which had traditionally been considered, planned, and operated independently, is necessary. Sector coupling allows to facilitate the integration of renewable energy, to enhance system flexibility and resilience, to foster economic growth, and to improve energy efficiency, and thus to create a more sustainable and efficient energy system.

The MCA-CBA tool has been used for performing a techno-economic assessment of energy planning alternatives for sustainable development of the energy sector in one region, considering four different system topologies, from the business-as-usual alternative -based on the adoption of traditional fuels- to the most sustainable ones -based on the integration of different vectors (e.g., electricity, gas and hydrogen).
The tool was integrated into an original methodology characterised by three steps: a) territory characterisation, to tailor resource availability, demand and potential supply within the specific area of interest; b) multi-objective optimal planning, to discover optimal trade-offs in a complex system characterised by multiple, often conflicting objectives (i.e., greenhouse gas emission reductions and costs minimisation) and c) ex-post multicriteria analysis (i.e., the MCA-CBA tool), to foster the identification of the most suitable solution among those discovered via optimisation, considering environmental, economic, energy sustainability and social aspects.

Compared to previous studies performed with the MCA-CBA tool, energy sustainability of the planning alternative has gained more emphasis. The decisional model was modified to identify four impact areas: energy sustainability, environment, monetary impacts and social impacts. Accordingly, suitable KPIs that are capable of covering the four impact areas, particularly those related to energy sustainability (i.e., utilisation of renewable sources and system efficiency, losses reduction, innovation level), the social area (e.g., the creation of new job positions) and the environmental area (i.e., pollutants emission reduction, carbon intensity, environmental impact), were identified. With these changes, the study gives due importance to new smart and sustainable approaches (e.g., sector coupling).

The methodology has since been applied to a particular territory characterised by greenhouse-gas-intensive industrial processes that depend on fossil fuels (e.g., coal, pet and oil shale) that, without any specific initiative, will suffer severe socio-economic consequences due to decarbonisation policies; the presented study aims to outclass them taking advantage of the energy transition possibilities.
The activity was performed together with RSE and Comillas Pontifical University.

Other Activities

Extension of the MCA-CBA multi-criteria cost-benefit analysis approach to include evaluation of projects involving flexibility services or "sector coupling" integrating different sectors (e.g., electricity, gas and thermal), which had traditionally been considered, planned, and operated independently, is necessary to achieve the energy transition goals.

The activity of integrating the different sectors started by analysing the state of the art of sector coupling. The international drivers that increased the interest in integrating different sectors, the most important benefits achievable, and the barriers that have to be removed in order to foster the adoption of such an approach were analysed.

To meet the new requirements, the MCA-CBA methodology was adapted from previous years of use. New evaluation criteria were identified, and the problem structure was revised, identifying four impact areas: energy sustainability, environment, monetary impact and social impact. Accordingly, new suitable KPIs were defined, with special attention on identifying indicators capable of representing the overall energy efficiency increase and the use of available resources.

The ISGAN MCA-CBA platform was then (after the adjustments described above) used for conducting studies focused on multi-energy planning at local level (i.e., provincial area), taking into account the interactions between various energy systems such as hydrogen, gas, and electricity, in order to support a sustainable energy transition in the examined area.
The studies conducted on the platform have confirmed the instrument's flexibility and its potential to extend its utility beyond the electrical domain including diverse energy carriers. The studies also contributed to a deeper understanding of the tool's strengths and weaknesses, paving the way for improving the tool with new functionalities (an activity that will be carried out during the current year).

Identification of regulatory frameworks to foster flexibility

WG3 has conducted a thorough and comprehensive investigation concerning the implementation of flexibility services in distribution network planning and operation. In this context, the importance of adopting modern planning tools for distribution network planning was underlined. Such new planning tools have to:

1. Integrate operation in planning taking into account the flexibility provided by distributed energy resources,
2. Abandon the traditional worst-case approach in favour of a probabilistic evaluation of network conditions,
3. Implement the stochastic network assessment to consider generation and demand uncertainties.

Also, flexibility services provision mechanisms were analysed, and the approaches proposed in the most important European pilot project were studied.

The Italian WG3 members, following the consultation launched by the Italian regulator for projects proposal for the experimentation of local ancillary service provisioning procedure (resolution 352/2021/R/eel), explored transparent and non-discriminatory market procedures to allow DSOs to benefit from local flexibility services to manage their network and cope with new requirements effectively. Local flexibility services to be offered were identified (i.e., voltage regulation and power flow control, load reduction and provision of reactive power to the TSO), and different mechanisms for DSOs' flexibility procurement were explored. In particular, market-based procurement was analysed, and market platforms already developed in Europe were observed.

The activity was performed together with e-distribuzione and Enel Grids.
National experts were invited to participate in round tables during CIRED conference.

4.3. WG5: Smart Grid International Research Facility Network

The Working Group 5 "Smart Grid International Research Facility Network" (short SIRFN) is a global collaborative initiative focused on advancing research and development in the field of smart grids. A smart grid refers to an intelligent electricity distribution system that incorporates advanced technologies to enhance efficiency, reliability, and sustainability in the power sector.

SIRFN brings together leading research facilities, academic institutions, industry partners, and government organizations from around the world. Its primary goal is to foster cooperation, knowledge exchange, and joint research projects among its member institutions.

Through SIRFN, researchers and experts collaborate on various aspects of smart grid technology, including renewable energy integration, grid modernization, energy management systems, demand response, energy storage, cybersecurity, and data analytics. The network provides a platform for sharing best practices, conducting experiments, testing new technologies, and validating innovative solutions in real-world settings.

By leveraging the collective expertise and resources of its members, SIRFN aims to accelerate the development and deployment of smart grid technologies on a global scale. This collaborative approach enables the exchange of insights, the development of standardized methodologies, and the identification of common challenges and solutions.

Overall, the Smart Grid International Research Facility Network plays a vital role in promoting international cooperation and advancing the state-of-the-art in smart grid technology, ultimately contributing to the transformation of the electricity sector towards a more sustainable and efficient future.

Within SIRFN, there is a strong focus on cutting-edge topics that are shaping the future of the power sector. Microgrids, which are localized energy systems that can operate independently or in coordination with the main grid, have gained significant attention. SIRFN facilitates research and development related to microgrids, including their design, control strategies, integration of DERs, and their ability to enhance grid resilience and energy reliability.

SIRFN members actively collaborate on exploring and advancing various aspects of the smart grid, with a specific focus on DERs. This includes studying the impact of DER technologies such as solar photovoltaics, wind turbines, energy storage systems, and demand response mechanisms on grid stability, power quality, and grid integration strategies. Additionally, SIRFN facilitates research into grid-forming inverter technologies, which are essential components in modern power systems enabling the operation of autonomous microgrids and active distribution networks. This research encompasses areas such as control algorithms, voltage and frequency regulation, and seamless integration within smart grid infrastructures. Furthermore, SIRFN supports research efforts dedicated to developing and testing innovative solutions for active distribution networks, which involve advanced monitoring, control, and automation capabilities. These solutions encompass intelligent grid management algorithms, advanced sensing and communication technologies, and demand-side management techniques.

Advanced testing methods, such as benchmark systems, real-time simulations, and co-simulation, are employed within SIRFN to evaluate and validate the performance of smart grid technologies. These methods allow researchers to assess the behavior of complex systems in a controlled environment, enabling the optimization of grid operation and the identification of potential issues.

Additionally, SIRFN members leverage Real-Time Digital Simulators (RCP) and Hardware-in-the-Loop (HiL) testing techniques. RCP allows real-time simulation of power systems, enabling researchers to analyze and validate control algorithms and protection schemes. HiL testing involves integrating physical equipment with simulation models to assess the interaction between grid components and validate their functionality.

Main Highlights from 2022

The Smart Grid International Research Facility Network (SIRFN) organized in 2022 a public workshop as part of the IRED conference, focusing on the grid integration of renewables. The workshop titled "Grid Integration of Renewables: The Role of Research & Testing Facilities" featured insightful panel and speech sessions.

One of the highlights was the panel session titled "How can Testing accelerate Renewable Energy Integration." This session brought together experts from research facilities, industry, and academia to discuss the crucial role of testing in accelerating the integration of renewable energy sources into the grid. The panelists explored topics such as innovative testing methodologies, grid performance evaluation, and the validation of renewable energy technologies. The discussions shed light on how testing can contribute to the seamless integration of renewables and address challenges related to grid stability, power quality, and reliability.

Another notable session was the speech session titled "Accelerating DER Development and Validation." Distributed Energy Resources (DERs) play a pivotal role in the transition to a sustainable energy future. This session focused on the rapid development and validation of DER technologies. Renowned experts shared their insights on topics such as advanced DER control strategies, grid-forming inverters, and the optimization of DER integration. The session emphasized the importance of research and testing facilities in facilitating the robust development and efficient deployment of DERs.

Overall, the workshop organized by SIRFN within the IRED conference provided a platform for exchanging ideas and knowledge among stakeholders in the renewable energy and smart grid domains. It highlighted the significance of research and testing facilities in advancing renewable energy integration and accelerating the development of distributed energy resources. https://ired2022.com.au/

Other Activities

DER testing protocols

The DER certification testing protocols group focuses on developing standardized testing protocols for Distributed Energy Resources (DERs) such as solar PV, wind turbines, and energy storage systems. These protocols aim to ensure the reliability, interoperability, and compliance of DER technologies with industry standards.

Microgrid Testing

The Microgrid Testing group concentrates on researching and testing microgrid systems. This includes evaluating the performance, control strategies, and integration of various DERs within microgrids. The group aims to enhance the resilience, stability, and efficiency of microgrid operations.

Power System Testing

The Power System Testing group focuses on testing and validating the performance of power systems. This involves evaluating the grid stability, power quality, and system resilience under various operating conditions and scenarios. The group aims to identify potential issues and develop effective solutions for improving power system performance.

Advanced Lab Testing Methods

The Advanced Lab Testing Methods group explores and develops innovative laboratory testing methods for smart grid technologies. This includes utilizing real-time simulations, hardware-in-the-loop (HiL) techniques, and other advanced methodologies to evaluate the behavior and performance of grid components, control algorithms, and integration strategies.

4.4. WG6: Power T&D Systems

Working Group 6: Power transmission and distribution (T&D) systems focuses on the potential system-related challenges in the development of future smarter grids. The Working Group works through knowledge sharing to facilitate the application of advanced technologies needed for power grids to contribute in the best way to the attainment of clean energy, climate goals and sustainable energy access to all.

The Working Group promotes solutions that enable power grids to maintain and improve the security, reliability and quality of electric power supply while facing challenges related to significant trends in the industry, like expanding electrification of the energy system to unserved areas, integration of large amounts of renewable energy sources and distributed generation, electrification of heat and transport, increased customer participation, replacing aging infrastructure and integration of emerging, real-time information technology systems.

Main Highlights from 2022

During FY 2022, WG 6 finalised six activities and started the work on 3 new activities. The focus areas helped to steer the activities and review the results.

The monthly calls were well attended by the national experts and updates and information were sent through monthly emails.

The WG organised one international high-level workshop in Paris together with IEA and 3DEN on "Flexibility for resilience in integrated systems" to enhance international collaboration and research, share best practices and provide policy guidance on deploying flexibility for resilience. Several WG6 members gave a presentation or joined the panel discussion at the IRED conference in Adelaide.

The WG reached out and was involved in various activities and groups, described as follows:
The WG cooperated with ETIP-SNET on the activity "Energy community embedment to increase the grid flexibility and to flourish the electricity markets". The cooperation with District Heating and Cooling TCP Annex TS3 "hybrid energy networks" (DHC TS3) continued and the final outcomes are being finalised. There were also discussions with IRENA on potential shared interest (long term scenarios). An introduction was given on a monthly call to the building-related TCPs and Buildings Coordination Group, since buildings make a large part of the electricity use,

and should be used as a resource, not just for peak shaving but to respond dynamically to the needs of the grid. The WG recognized that cooperation with utilities and trust building are crucial. The group also recognized the important role of decarbonization of the built environment and the need in decarbonizing both heat and electricity. WG6 also got an introduction to TCP WindTask 25 "Design and operation of energy systems with large amounts of variable generation". Many of the topics are relevant for WG6, for example on long-term planning, flexibility and market design and it would be interesting to support each other, at least with joining workshops or reviewing some outcomes.

Within ISGAN, there was an intensive cooperation with the KTP team (part of the communications working group) on the activity on 'Network planning decision making under uncertain scenarios'. WG6 also cooperated with WG9 on the survey on TSO-DSO-Stakeholder interaction, and is scoping for shared activities in the next year as well.

Several EU funded projects such as Flexplan and CoordiNet provided valuable input to the WG.

Other Activities

Hybrid Energy Networks

A joint activity with IEA DHC ANNEX TS3 to provide a holistic approach for designing and assessing hybrid energy networks and flexible sector coupling including electricity networks, district heating and cooling and gas networks, to enable the storage and distribution of energy across them. WG6 shared a common workshop and provided input to the SWOT analysis.
In 2022, document review and writing an introduction were performed by WG6.

System and flexibility services – the CoordiNet view

Activity in cooperation with the CoordiNet project to demonstrate how DSOs and TSOs can act in a coordinated manner to procure grid services in the most reliable and efficient way.

In 2022, the WG gave a presentation of the final roadmap 'Roadmap towards a new market design including the implementation of the standardized products for grid services' during a WG6 coordination call. WG 6 also provided input, through a survey, to a policy brief 'Towards Coordinated TSO-DSO Markets for the Provision of System Services'.

Flexibility and storage as an alternative to building new grid infrastructure - the FlexPlan view

Activity in cooperation with the FlexPlan project, which aimed to answer the question of which role flexibility can play and how its usage can contribute to reduce planning investments yet maintain (at a minimum) the current system security levels. WG6 provided input acting as advisory board members, by joining meetings and by filling in web consultations throughout the project, while regular updates were given in the WG calls.

In 2022, WG6 reviewed the final paper 'Lessons and recommendations on Pan-European level regulation, policies and strategies'.

Flexibility for Resilience

Activity in collaboration with ETIP-SNET. In 2022, a high-level workshop was held in Paris between ISGAN, IEA and the IEA Digital Demand-Driven Electricity Networks (3DEN) initiative to enhance international collaboration and research, share best practices and provide policy guidance on deploying flexibility for resilience. The outcomes were summarized in a policy brief 'Flexibility for resilience in integrated systems'.

Flexibility harvesting from renewable energy sources and its impact on TSO-DSO interaction

An activity in collaboration with ISGAN WG9 to provide an overview of various flexibility topologies within transmission and distribution networks and to describe their subsequent impact on the interaction between the TSO and DSO.

In 2022, both a report presenting results from the survey to gather insights as well as the report 'Flex-

ibility and its impact on stakeholder interaction' was finalized. Presentations on the topic were given at several occasions, such as at the workshop in Paris.

Cooperation with IEA and 3DEN (Digital Demand-Driven Electricity Networks) project

An activity to create closer interaction between IEA, IEA projects and ISGAN. The 3DEN project (Digital Demand-Driven Electricity Networks) aims at providing guidance to policy makers on the policy, regulatory, technology and investment context needed to accelerate progress on power system modernisation and effective utilisation of demand side resources.

During 2022, WG6 reviewed some deliverables and a joined workshop was held in Paris on 'Flexibility for resilience in integrated systems', to enhance international collaboration and research, and to share best practices.

Network decision making under uncertain scenarios (cooperation with KTP)

International knowledge sharing project with the goal to contribute to the development of robust, efficient and transparent network planning processes in line with, and supporting, the realization of the global sustainable development goals. The main work of this activity is done via interactive workshops. Two digital workshops were arranged in 2022.

Aggregator roles in digitalized energy systems

The activity addresses the existing international aggregator best practices where the ICT solutions can enhance the coordination between aggregators, system operators, and consumers.

During 2022, desk research was performed to address technical and/or non-technical challenges for enhancing aggregator roles in digitalized energy systems.

Energy community embedment (cooperation with ETIP-SNET)

An activity in cooperation with ETIP-SNET that investigates what kind of impact local energy communities can have on the electricity grid, and how they can increase grid flexibility and support electricity markets. Gaining insights into the conditions for installing successful local energy communities will help with the replication of best practices, and the development of recommendations for local or national authorities.

4.5. WG7: Smart Grid Transitions

The main objective of this Working Group is to investigate institutional change associated with Smart Grid deployment. Using the framework of transition management, this Working Group aims at sparking off an international, coordinated trans-disciplinary research activity in the social sciences supporting and complementing technology oriented Smart Grid activities. This Working Group also intends to collect information and knowledge from innovation studies, political sciences, institutional economics, sociology and energy law, and make it palpable for policymakers and other stakeholders.

This Working Group, in particular, aims at supporting policymakers in the field of Smart Grids by focusing on the direction, efficacy and efficiency of the energy system transition. In order to complement other ISGAN Working Groups, non-technical aspects and framework conditions conducive to Smart Grid deployment are at its focus, by addressing societal needs, political governance, policies, regulatory aspects and human behavior taking into account the diversity of institutional structures and governance traditions of ISGAN countries.

Main Highlights from 2022

In recent years, ISGAN-WG7 has been very successful in setting topics and establishing an international network of policy making in the field of regulatory experimentation, both at the international and national level. Due to the successful KTP workshop series in 2021 after the "Regulatory Sandbox 2.0 Project" initiated by the "Sandbox 2.0" team (WG 7, Communication Working Group) and the great demand for international exchange of experience and learning processes, the ISGAN Sandbox Community of Practice (CoP) was established with regular meetings of experts and practitioners from interested countries. The CoP enables self-organized, regular meetings to promote international exchange on sandbox programs, national experiences, as well as learning and "good practices". The online-meetings have been developing equally successful as a global platform for fruitful exchange, and have been visited by up to 14 participating countries. Several countries have benefited greatly from these activities in designing new sandbox programs or revising them. The expertise of the ISGAN WG7 is requested by the European Commission, other European institutions and is taken up by international associations of regulatory authorities.

During the ERRA-MEDREG Workshop on Regulatory Sandboxes in Istanbul on 6 December 2022, in exchange with representatives of regulatory bodies, it was highlighted several times by experts and practitioners that regulatory learning is the key reason for conducting regulatory experimenting, not the fostering of innovation for its own sake. From the regulatory bodies' side, it is clear that the main and most influential driver for the need of experimenting is the goal of reaching grid or network decarbonisation. This requires strategic thinking and planning of experiments with a clear challenge driven focus. In parallel, the digital transition is taking place and this causes reactive pressure on regulators with respect to fast technological change.

These activities and publications provide the policy conclusions of the ISGAN Sandbox 2.0 project developed for the CEM12 in 2021 and contribute to the establishment of international standards, especially for regulatory sandbox programs for the transformation of energy systems, and to the lively exchange of information in the ISGAN Sandbox Community of Practice on good practices and challenges in the implementation of such programs.

Decentralization and integration

Under the scientific lead of the Dutch expert Prof. Anna J. Wieczorek, the topic "Decentralization and integration" was developed from the perspective of Sustainability Transitions, leading to two scientific journal articles (both in review). In the first step (paper 1), different approaches to the organization of decentralized energy systems at the grid edge were developed and compared. Based on the two dimensions of value orientation and service orientation of the actors at the grid edge (e.g. individual households, energy communities, aggregators and storage providers), four emerging ideal types of decentralization configurations are identified and an analytical system is developed from which dominant forms of decentralization are derived.

Value orientation → **Service orientation ↓**	**Individual values**	**Collective values**
Outward services	Individual-Outward: e.g. System oriented prosumers and consumers	Collective-Outward: e.g. System oriented energy communities
Inward services	Individual-Inward: e.g. Self-service oriented prosumers and consumers	Collective-Inward: e.g. Self-service oriented energy communities

Forms of decentralization configurations at the Grid-Edge

The four configurations result on the one hand from the alternative of individual and collective forms of organization and on the other hand from the logic of the respective business model, whether energy services (PV electricity production) and service provision (e.g. demand response, electricity storage capacities), whether internally (e.g. members of an energy community, industrial companies) or externally (e.g. to network operators and aggregators). This system thus enables the examination of the effects of the strategies and investment decisions of actors at the grid-edge and on the future smart grid architecture.
In the second step (paper 1), potential lock-ins/path dependencies were examined on the pathways to alternative, emerging configurations of decentralized energy systems that meet the need for a carbon-neutral energy future. The analysis is based on the four ideal-typical decentralization configurations identified in the first step. A forward-looking approach to various lock-ins that may arise on the way to decentralized futures is being pursued. On the basis of certain use cases, the effects that such future lock-ins of different types (material, institutional, behavioral and discursive lock-ins) can have, are outlined as examples and the associated challenges for the sustainability of decentralized energy futures and the smart grid required for these architectures, are analyzed.

Mission-orientation of Smart Grid Related R&I Policy Making

For several years, OECD has been discussing mission-oriented policies for net zero and the need to coordinate this across multiple policy areas and the need for change in multiple "systems" (e.g. energy, transport, buildings) in order to deliver this system-wide transformation. Mission-oriented innovation approaches (or MOIPs) can help promote such systemic change due to their integrated nature. MOIPs, which are increasingly adopted by countries to address a wide variety of societal challenges, are expected to improve coordination over traditional innovation policies through the collective development of a strategic agenda, the setting of a dedicated governance structure, and the implementation of a tailor-made and integrated policy mix' (Larrue 2022)

In the practice of Smart Grid Transitions, it is becoming increasingly clear that established innovation policy making for sustainable energy transition, in this context, faces a dilemma with established technicalities of how R&D projects are approved. Since the Technology Readiness Levels (TRL) serve as a key criterion for program design and selection of eligible projects, it is becoming increasingly difficult to conduct larger-scale scientific projects on Smart Grids Transitions. As not all research and innovation projects focus on technology, but on organizational, institutional, social innovations as part of broader system innovations that are equally required for the socio-technical transition, technology readiness alone is an inadequate measure. Thus, to resolve the dilemma, a conceptual framework needs to be developed. The work in WG7 in 2022, initially analyzed the changing role of technology in innovation and innovation policy in the fundamental transitions in the production and consumption systems (PCS) of energy, through the social dimension and increasing importance of elements of public services on the one hand and on the other hand through the role of digitization in socio-technical systems.

Based on the scientific literature on smart grid transitions, seven modules that must have a certain level of readiness to enable a transition have been identified: Technological readiness, Functional maturity of energy systems, Market maturity of energy systems; Readiness of the economic system, Institutional readiness, Ecological readiness.

This results in conclusions for the development of future research and innovation programs for the transition of the energy system with smart grids, of which the maturity of solutions for the energy transition should not be made solely dependent on the technological maturity. However, the proportion of public funding that is made available to innovators is currently dependent solely on technological maturity. In addition, currently discussed alternative concepts such as "system readiness" or "institutional readiness" are being worked on how they can play a role in practice.

The conceptual work to date has resulted in a scientific conference paper entitled "Transformative Readiness - Unpacking the technological and non-technological aspects of sustainability transitions", which was presented at the International Sustainability Transitions Conference 2022 with the expert community. The paper will be further developed for publication in a journal in 2023.

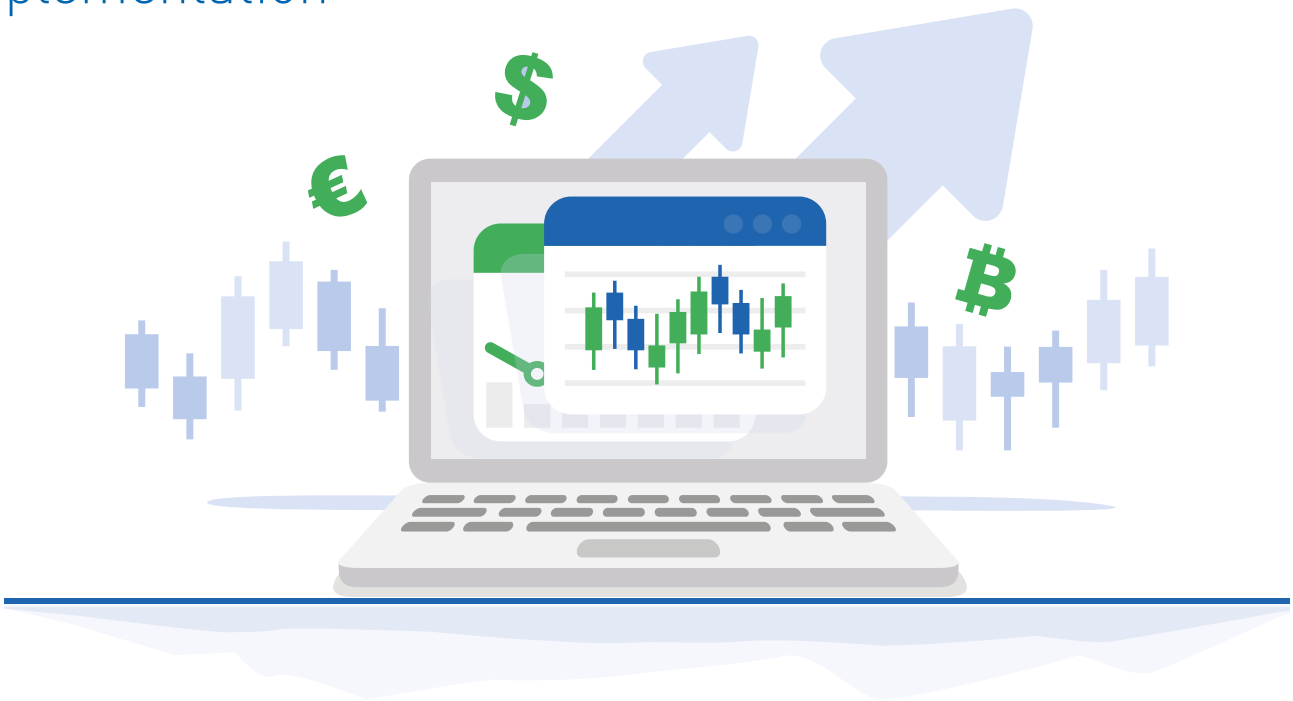
Other Activities

Sandbox Community of Practice

The Sandbox Community of Practice online meeting was held on 30.11.2022 organised by OFGEM and Comillas Institute of Research, with participants from Spain, Austria, Canada, Finland, Italy, Sweden, Israel, Australia, United Kingdom, The Netherlands, Germany and IEA/EMS/EEFD.

Presentations were held by OFGEM on the update on changes between Sandboxes 1.0 and 2.0 and Spain presenting on the state of developments regarding legal basis and steps towards a sandbox program for the electricity sector.

4.6. WG9: Flexibility Markets – Development and Implementation



Energy systems around the world are facing the greatest levels of change they have ever seen, driven by the need for decarbonization, the rapid growth of decentralized renewable energy that are intermittent by nature, and the explosion in new consumer technologies enabling more solutions than ever. Greater levels of flexibility, or the ability to change the behavior of generation and consumption in response to the availability of supply, is seen as an enabling feature needed to decarbonize the world's energy systems-particularly from the historically inflexible demand side. Adaptions to market environments that better reveal and reward the value of such flexibility are currently under development in a number of countries, and the successful design of such markets is critical to the successful transition to low carbon energy systems. The scope of this Working Group 9 involves all aspects of market design for power system flexibility. This includes: the whole range of market timescales, from long term investment signals to second-to-second balancing and response; the whole physical system from large centralized generation to behind the meter sources of flexibility within domestic settings and interfaces with other vectors; all sources of value that flexibility conceivably could capture, going beyond MWh to include characteristics like voltage control, repeatability, inertia, locational constraint alleviation; and aspects of the market that go beyond the trading rules such as consumer support, or how obligations (such as with respect to grid stability) are understood and checked.

Main Highlights from 2022

Data-sharing standards and protocols: UK Insights
This paper draws on the work carried out in the UK by the Energy Data Taskforce (EDT) and how its recommendations pertain to and align with flexibility service provisions and market developments in the UK. Insights from relevant energy stakeholders (networks, industry/innovation and academia) have also been incorporated.

The following conclusions can be drawn from the review done on the EDT recommendations and the inputs received from UK flexibility experts:

- Clear locational breakdown and consistency is needed with open flexibility data at national level supported by regionalized data
- Consistency in data publication is needed with set standards, e.g., the Oil and Gas Authority (OGA) makes legally binding requirements on oil and gas companies to publish certain data sets to an open platform
- The data needs to be open and free for all with the necessary support from organizations who can manage and control the access, open or chargeable

Link to paper: https://www.iea-isgan.org/data-sharing-standards-and-protocols-uk-insights/

TSO-DSO Coordination: The UK Case

There are many developments around flexibility within the energy system, particularly around electricity network reinforcement avoidance and trading platforms. Moreover, flexibility has been instrumental in developing the Distribution System Operators (DSO) markets in the UK from the ground up. The UK Energy Networks Association (ENA)[1], through the Open Network project, connected all the key stakeholders in the flexibility landscape to identify the fundamental principles of flexibility and has evolved over the years to a market-leading status within the UK. As of 2021 3 GW of contract or other tender flexibility were procured within the UK. A key focus in the years to come is the coordination or alignment of processes and procedures within DSO and ESO2.[2]

However, as identified by the WG 9 Programme of Work (PoW), there are also significant gaps in this area that could hinder the participation of innovators in the flexibility markets and, at the same time, limit the procurement process for network companies. Through this insight paper, we have attempted to capture the views and insights from experts within the UK by developing a list of questions and conducting interviews based on them. Questions were compiled based on inputs from government and network stakeholders and were then communicated with national experts for their views. This paper aims to draw out the key takeaways from those interviews and surveys under five key topics identified by the participating experts in this area. In addition, it should be noted that the information herein represents insights from a range of experts. Therefore, they should potentially represent more or less essential elements for flexibility markets. Having said that, the insights should be seen as indicative and not a final or comprehensive set of requirements.

Other Activities

End-Use Flexibility Characterization and Grid Utilization

Current implementations of flexible loads largely focus on capturing them from large industrial systems for application to basic transmission-level services (such as those associated with capacity, congestion, and reserves); however, there is interest in widening its potential. This task aims to i) broaden understanding of what flexibility means from an end load, including storage, perspective and ii) examine its possible application to a wide range of grid services/needs, for today and in the future.

Beyond current applications, it is also recognized that there are different perceptions to what it means to be 'flexible,' adding to barriers hindering its full potential. Part of this work will be fashioning communications understandable to power and non-power system experts alike, including policy makers, building managers, market designers, etc. To achieve this, a taxonomy describing the different layers of flexibility will be established to help quantify potential for the different grid services that can be supported to serve the needs of the current future power system.

[1] Energy Networks Association (ENA), is the industry body representing the companies which operate the electricity wires, gas pipes and energy system in the UK and Ireland

[2] https://www.energynetworks.org/newsroom/a-flexibility-first-approach-unlocking-capacity-opening-markets-powering-towards-net-zero

Consumer focused flexibility

The activity aim focuses on the consumer of electricity and studies how these consumers can be incentivized to consume electricity more flexibly. The focus is on relevant business models that encourage flexibility from consumers, policy models, methods for customer dialogue and barriers on the one hand, and potential business models for how DSOs can utilize flexibility from different types of customers on the other hand.

Interoperable Markets

The aim of the Interoperable Markets Task is to increase understanding of the processes, systems, actors and activities required to facilitate the synergistic integration of different flexibility markets (and associated products and technologies) and the steps necessary to integrate these interoperable markets into the wider future smart energy system. In order to achieve this, it is necessary to gather knowledge and deepen understanding of the current structures, processes and arrangements associated with existing flexibility markets (and energy markets more broadly) and the provision of flexibility.

Operational Planning

This Task's aim is to answer the question on how system planners can adapt their strategies, and how they can take advantage of accessing local flexibility markets. To answer this question, the interaction between different markets, the development of a methodology to derive flexibility potential for different technologies, and the quantification of flexibility sources within a region is relevant.

5. ISGAN ExCo Meetings 2022

Twice a year the ISGAN Executive Committee meets for the ExCo meetings. Due to the Corona Pandemic between 2019 and March 2022, only virtual meetings took place. In October 2022 the first in-person meeting took place after the pandemic induced long break.

The members of the Executive Committee, the Working Group Managers, Task leads and Secretariats attend these meetings.

The Agenda includes reporting about activities of the Working Groups, strategic discussions, as well as workshops and presentations of IEA, CEM and guests from other organizations.
Countries that are interested in joining ISGAN in the future are invited to attend these meetings as observers.

In conjunction to the three-day long ExCo meetings workshops, conferences and meetings of the ISGAN community take place.

5.1. ISGAN ExCo 23 (virtual Meeting)

The 23rd Meeting of the Executive Committee of the International Smart Grid Action Network (ISGAN) took place March 9th-11th, 2022 as a virtual meeting.

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23rd Meeting of the Executive Committee of ISGAN

During this meeting **ISGAN's cooperation with several other initiatives**, IEA TCPs and organizations acting in the field of Smart Grids, was discussed. It is ISGAN's aim to deepen the cooperation with the most important organizations, bring them to the Working Group level, and ensure mutual benefits from the cooperation. This undertaking is supported by liaison persons. These are members of ISGAN, who are also active in the respective partner organisation, and have the task of ensuring the flow of information between the two organisations. Furthermore, the Working Groups presented the results from the past year and their Programmes of Work for the following year. For the first time, the Communication Working Group presented a unified Programme of Work for 2022. However, this very important Working Group within ISGAN was still searching for a Manager. Vida Rozite, ISGAN's Desk Officer from the International Energy Agency (IEA), presented an overview of recent publications, events and plans of IEA including reports, commentaries, and articles. Vida gave an overview of the *Digital Demand-Driven Electricity Networks Initiative* (3DEN) founded by the Italian Ministry of Ecological Transition and operated by the International Energy Agency (IEA) with the support of the UN Environment Programme (UNEP) in order to accelerate progress on power system digitalization, modernisation and the effective utilisation of demand-side resources.

Ellina Levina, delegate of the Clean Energy Ministerial (CEM)-Secretariat, presented the CEM 3.0 phase. This new phase started off with all members committing to increase all activities and initiatives for ambitious outcomes. The following strategic discussion session was related to this initiative:

Strategic Discussion Sessions:

In order to meet the wish of the ExCo to allocate more time for strategic matters during ExCo meetings and to stimulate active discussions among ExCo representatives, discussion sessions are added in parallel to the regular ExCo-meetings, and shall include the following elements:

- Stimulate active discussions among all ExCo representatives
- Discuss issues of strategic importance
- Abstain from taking votes or making decisions
- Take minutes of each of these sessions and include them in the ExCo meeting minutes
- Present the results of the discussions in the plenary sessions after the parallel sessions and take votes, if necessary.

The topics for this year's parallel sessions were strongly motivated by the following: CEM is entering a new phase, the focus of which is on a **more ambitious implementation** and deployment of clean energy technologies. This means setting ambitious and tangible goals for all CEM workstreams, making sure that all CEM workstreams are effective in their operations, showcasing them, so that CEM becomes visible and prominent as a platform for clean energy deployment.

Furthermore, as the **CEM Power System Flexibility (PSF)** campaign closed in 2022, it was discussed how ISGAN may pick up some of the issues addressed by the PSF. ISGAN integrated parts of the PSF Campaign and Collaboration into other CEM workstreams, as a follow up to the Horizontal Accelerator Outcome.

Furthermore, ISGAN Award of Excellence gave their update. Also, the 8th ISGAN Awards consisted of two parts for the first time. The first part was done together with the Global Smart Energy Federation (GSEF) concerning EV integration in Smart Grid. The second took place in cooperation with the CEM Empowering People Initiative on the topic of Smart Grid Workforce Development for an inclusive energy transition.

5.2. June 2022: a virtual extraordinary ExCo meeting

In June 2022, a virtual extraordinary ExCo meeting took place, which was necessary to establish the new Working Group Manager for the Communication Working Group. In conjunction with the last Request for Extension of ISGAN, which was approved in September 2021, the Executive Committee prioritized ISGAN knowledge exchange and communications functions through the creation of a single, multi-faceted Communication Working Group (WG) bringing together several previously existing Annexes. This Working Group needed a Manager. A very promising candidate, Daniel Wuebben, was proposed by Spain and voted for by the Executive Committee during this extraordinary ExCo meeting.

5.3. ISGAN ExCo 24 in Adelaide, Australia

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Delegates to the 24th meeting of the ISGAN Executive Committee

The delegates of ISGAN were very pleased that a face-to-face meeting took place again after the pandemic. The 24th meeting of the Executive Committee of ISGAN took place in October 2022 invited by the Commonwealth Scientific and Industrial Research Organisation (CSIRO), on 26-28 October 2022 in Adelaide, South Australia.

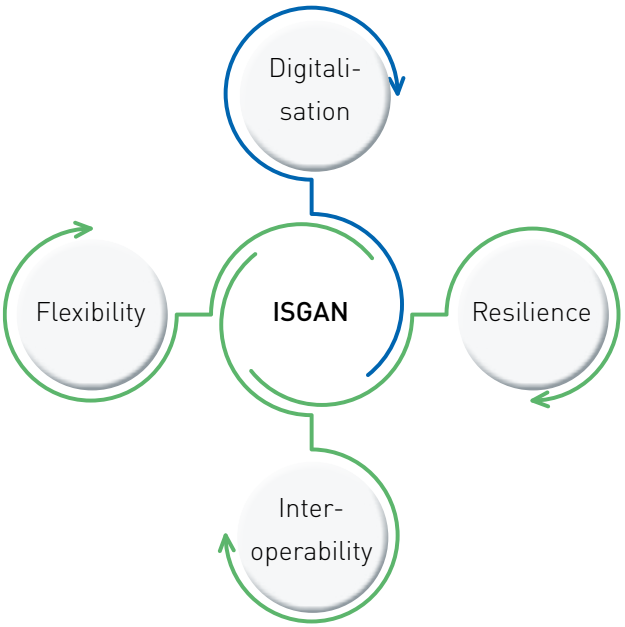
In conjunction with the Executive Committee meeting, the 9th International Conference for the Integration of Renewable & Distributed Energy Resources (IRED 2022) was held 24- 27 October in the same location. A detailed description of ISGAN's contributions to IRED 2022 can be found in chapter 7.1.

In order to make the most of the opportunities offered by a face-to-face meeting, many interactive sessions were held at this meeting.

One interactive workshop started a **discussion on the ISGAN themes:**
To highlight some of the core objectives and means for achieving smarter electricity systems, ISGAN identified the following themes:

- Power system flexibility (2016)
- Digitalisation (2016)
- Resiliency (2017)
- Interoperability (2019)

ISGAN Themes



During this interactive workshop, participants interacted to discuss the current themes and to propose new themes. ISGAN themes serve as key focus areas for the work conducted with the working groups and reflect the national priorities and goals of member states.

- ISGAN's Strategy needs to reflect national climate goals;
- ISGAN needs to support countries to reach their goals.

At a **World Café-session**, the working groups presented and discussed highlights. This session encouraged close interaction between the Working Group Managers and ExCo members. ExCo members made suggestions based on their national strategies and goals and gave inputs what working groups should consider in their subsequent Programmes of Work.

Instead of with Powerpoint-presentations, all Working Groups presented their results in an interactive World Cafe. The ExCo members made suggestions based on their national strategies and goals on what Working Groups should consider in their next Programmes of Work.

This form of interaction is only possible at the 2nd meeting of the ISGAN Executive Committee in the calendar year, because then there is no need for votes on Programmes of Work. Furthermore this session allowed to have time for deeper discussions. A written document was prepared by each Working Group Manager that provided an update already prior to the meeting, which also helped prepare the members of the Executive Committee with focused questions.

Working Group Managers need inputs from the countries so they can adapt their work to reach strategic goals, to make the most out of the work done in the Working groups by sharing information, and to steer the Working Groups so that results support members'national priorities and aims.

Discussion: Interaction with other organizations.

In the last years, ISGAN invited several organizations to interact with ISGAN. With the growing number of organizations in related fields yet with limited resources, ISGAN discussed the need to focus on a small number (e.g. the three) of most important organizations with whom to work closely. Others should be kept updated on the latest results and plans.

Background Information

One of ISGAN's key activities is centered around reaching out to and cooperating with external stakeholders, clean energy initiatives, and similar target groups to align aims, avoid overlaps and share knowledge. However, with limited resources, a strategic decision needs to be taken to define cooperation partners with whom there will be strong interaction and joint work as opposed to others, with whom only information is shared.

6. ISGAN Publications 2022

ISGAN's working groups were very productive in 2022, having produced numerous publications. As part of the development of the ISGAN communication strategy in cooperation with an external consultant, ISGAN members analysed and classified their stakeholders. A distinction is now made between ISGAN internal and external stakeholders and between experts and non-experts. During this process it was analysed which communication channels and methods are best suited for which of the stakeholder groups in order to achieve maximum impact.

In line with these analysis, ISGAN publishes its results in different communication products in order to make the information available on different levels of detail:

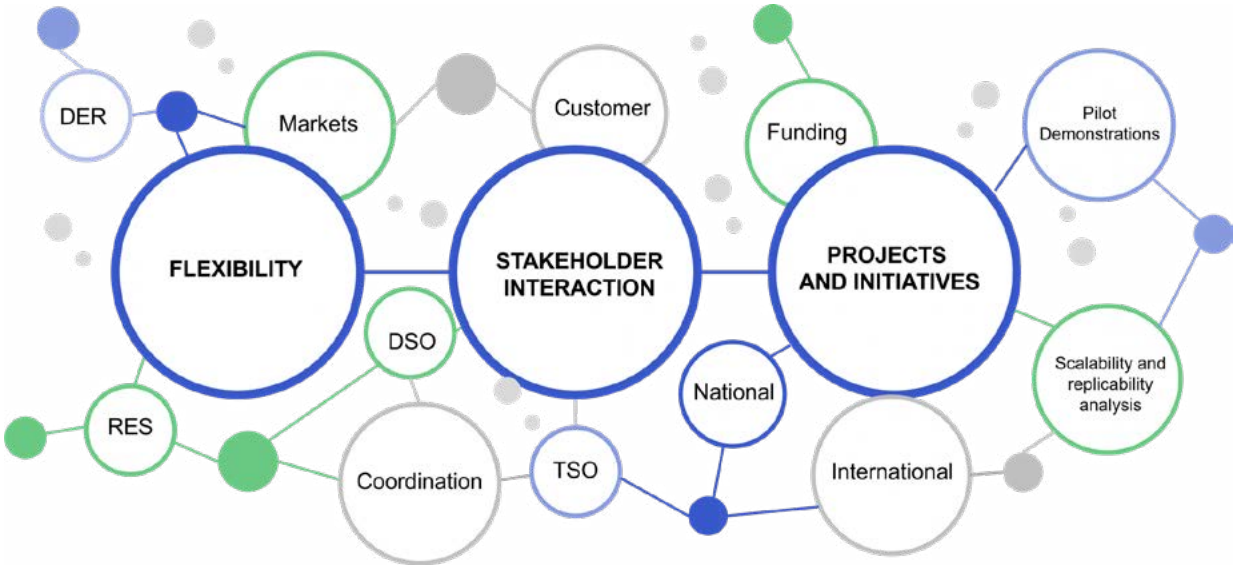
- Policy briefs for policy makers.
- Discussion papers for researchers.
- Films for the general public.
- Webinars for researchers and application experts.

In the following chapters the publications of ISGAN working groups are listed:

6.1. Flexibility harvesting and its impact on stakeholder interaction – key messages

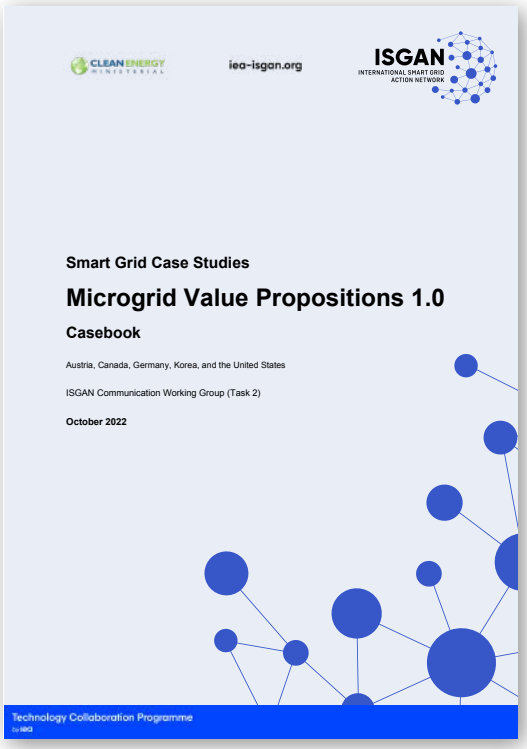
The electrical energy system is transitioning in the way electricity is generated, transmitted and distributed. Due to these changes, system operators are faced with various challenges (technical, ICT, regulatory and economic) to accommodate new technologies due to the drive toward modern power systems. However, these changes also allow for the increased opportunity for system development and the inclusion of new market players. Flexibility will provide network operators (together with other stakeholders such as prosumers, aggregators, etc.) with the possibility to increase the stability of the electrical system and ensure the safety, security and reliability of supply. Stakeholder interaction is key to facilitate and enable the integration and utilization of flexibility in future power systems. This document highlights the key messages for all relavent stakeholders in the power system on the topic of flexibility harvesting.

ISGAN - Flexibility harvesting and its impact on stakeholder interaction - key messages (iea-isgan.org)



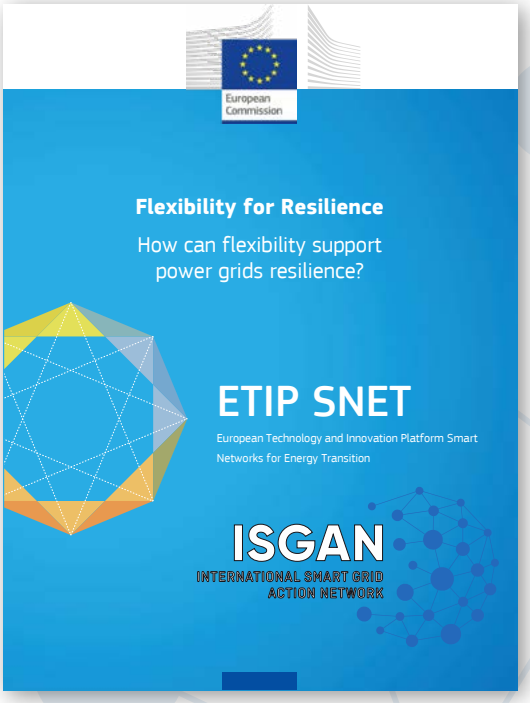
6.2. Casebook Microgrid Value Propositions 1.0 (CWG)

This casebook seeks to understand the technologies, business models, scale, and vendor landscape supporting microgrids that are commercially viable.
This casebook reflects how ISGAN can gather experts and stakeholders globally to increase the awareness of a microgrid technology in the field of smart grids. At this stage, the casebook features five cases conducted from four different countries including Austria, Canada, Germany and Korea, primarily from a business model and economics standpoint.
ISGAN Word Template - Preview (iea-isgan.org)



6.3. Flexibility benefits for resilience: how can flexibility support power grid resilience?

As zero operational-cost variable Renewable Energy Sources are foreseen to dominate the future energy mix, and the abundance of green electricity will allow the replacement of fossil fuels in sectors such as heating, cooling, industrial processes, and transportation. The intermittency of such energy resources, however, implies significant systemic requirements for flexible solutions; thus, developments of the energy sector in general, and the power system in particular, instigate significant innovation activities in the fields of power system flexibility. Concurrently, complexities and interdependencies of system components and the multitude of actors increase the risks of service failures and the complexity of production and grid planning, raising the demand for stronger and more agile resilience means and countermeasures. In this white paper we discuss the item "How can flexibility support resilience?", considering the increased societal needs of a secure electricity supply. A report summarising experiences from a large number of initiatives in a collaborative effort between of ISGAN WG 6 and ETIP SNET WG1.
2022-ISGAN-WG6_Flexibility-for-Resilience.pdf (iea-isgan.org)



6.4. Data-Sharing Standards and Protocols: UK Insights

In the power sector, data is key to unlocking flexibility, bringing system and consumer benefits and managing the transition to a low carbon economy. This factsheet draws on UK experience to present insights into different attributes of data and its role as an enabler to facilitate interoperable flexibility markets.

This paper draws on the work carried out in the UK by the Energy Data Taskforce and how its recommendations pertain to and align with flexibility service provisions and market developments in the UK. Insights from relevant energy stakeholders (networks, industry/innovation and academia) have also been incorporated.

6.5. TSO-DSO Coordination: the UK case

With increasing requirements for flexibility in electricity grids, the coordination between operators of the transmission and distribution networks becomes increasingly crucial. This paper attempts to capture the views and insights from experts within the UK on this topic and the UK experience.

There are many developments around flexibility within the energy system, particularly around electricity network reinforcement avoidance and trading platforms. However, there are also significant gaps in this area that could hinder the participation of innovators in the flexibility markets and, at the same time, limit the procurement process for network companies. This insight paper attempts to capture the views and insights from experts within the UK and draw out the key takeaways.

6.6. Flexibility and its impact on stakeholder interaction

Flexibility within the electrical power system is becoming an increasingly prominent and sought-after solution, which can be utilized by both the Transmission System Operator and Distribution System Operator to solve/avoid network problems such as network congestion, voltage violations, system balancing etc.

To adapt to the various changes, the interaction between stakeholders within the electricity supply chain is becoming increasingly more important. These interactions, despite their various challenges, provide many opportunities for increased efficiency of the operation and planning of modern networks in the future. To utilize flexibility to its full potential, coordination between various stakeholders within the energy supply chain is required. The increased need for stakeholder interaction relies on the advanced collaboration between respective parties, which needs to be facilitated through technology advancements, data exchange mechanisms, regulatory considerations, and economic analysis.

To evaluate the various perspectives on the flexibility and stakeholder interaction, a survey was launched, and its findings are presented in this report. The results of this survey provide an overview of flexibility and stakeholder interaction based on the various perceptions from a wide range of respondents from different geographic locations and sectors. The survey highlights the current status of the related topics and allows for the opportunity to identify concepts, such as challenges and opportunities, which require increased attention by all stakeholders in modern power systems of the future. This work provides a foundation for future work, which will be conducted in the next phase within Working Group 6 and Working Group 9.

6.7. Scoping study for ISGAN Working Group 9

This paper summarises the results of a study conducted at the inception of ISGAN Working Group 9. It seeks to identify gaps in research on flexibility issues, to provide a focus for Working Group 9.

Many developments are taking place around flexibility within energy system(s), particularly around electricity network reinforcement avoidance and trading platforms. However, the scoping study hypothesis was that there are also significant gaps in research. As such, the study conducted a literature review to confirm areas that are being considered and concurrently surveyed ISGAN member countries to gather additional thoughts and concerns.

Conclusions were that there are areas that still need to be addressed, namely:

1. Integration of trading with dispatch;
2. Understanding the multiple actors, the requirements (including where those requirements are conflicting) for flexibility; and the commercial implications;
3. A need to identify the characteristics that different flexibility options provide and how to access them;
4. Identifying Interoperable markets to support the development and usage of flexible products and services at scale;
5. Consumer focused flexibility,
6. Avoiding stability/security of supply issues through loss of diversity.

This report summarises the findings of the literature study and the survey, and explains the thought leadership, to date, in the areas described as gaps above.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7. ISGAN events

7.1. IRED 2022

IRED 2022 | 9TH INTERNATIONAL CONFERENCE INTEGRATION OF RENEWABLE & DISTRIBUTED ENERGY RESOURCES

The 9th International Conference for the Integration of Renewable & Distributed Energy Resources (IRED 2022) gathered researchers from 14 different countries to share information on state-of-the-art technologies, research, and applications. ISGAN delegates and experts played a key role. IRED 2022 was held in Adelaide, Australia, and organized by John Ward and his team at the Commonwealth Scientific and Industrial Research Organisation (CSIRO).

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John Ward of CSIRO opening IRED-2022

A dedicated session of Mission Innovation's Green Powered Future Mission (GPFM) was chaired by ISGAN Chair Luciano Martini. ISGAN and the GPFM signed a Memorandum of Understanding in September 2022 at the GCEAF (CEM13/MI-7) in Pittsburgh, to formalize their collaborations

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Delegates from Green Powered Future Mission taking part in the IRED-2022 conference

Ron Brandl, manager of ISGAN's Working group 5, the Smart Grid International Research Facility Network, introduced the importance of international research collaboration. Next, Mihai Calin, Operating Agent of ISGAN, hosted a panel "How Can Testing Accelerate Renewable Energy Integration?".

Another panel session discussed the topic "Running the Grid on Renewables (Flexibility and Community Energy)" with contributions from Joni Rossi, Working Group Manager of the ISGAN Working Group 6, Power Transmission and Distribution Systems, Heather Smith, Alexandre Prieur, alternate delegate from Canada and Jose Pablo Chaves, Task Manager for The ISGAN Academy.

Further contributions included the Austrian expert Barbara Herndler, presenting the results from the Working Group 6 task on DSO-TSO interaction and Helfried Brunner, ISGAN delegate from Austria on "Methods and scenarios for strategic grid planning in distribution networks (Project 567)". Finally, Matteo Troncia and Jose Pablo José Pablo Chaves from Spain won the 2022 IRED Poster Competition for their submission, "Flexibility Markets for Voltage Control in Transmission and Distribution Grids: Quantitative Assessment of a Realistic Case Study." Several of the posters were contributed by ISGAN's Working Group 5 Smart Grid International Research Facilities Network. For more details of the conference, please visit IRED 2022

7.2. IEA and ISGAN workshop: Flexibility for resilience in integrated systems

ISGAN and IEA's Digital Demand-Driven Electricity Networks (3DEN) Initiative have co-organised the international high-level expert workshop "Flexibility for resilience in integrated systems" to enhance international collaboration and research, share best practices and provide policy guidance on deploying flexibility for resilience.

This workshop gathered international experts to present and discuss how innovative flexibility services can be developed to support grid operation with high penetration of renewable energy sources, bringing evidence from ongoing analysis and successful projects. It also discussed how these services can be integrated in the investment planning stage, thus building up resilience to future-proof power systems in the long-term.

A particular focus was on emerging economies and developing countries. Oftentimes being the most affected by severe events, there is an opportunity to build in resilience while still expanding and developing their power systems in line with growing electricity demand, rather than having to retrofit existing assets.

The workshop featured interventions by IEA, ISGAN, the Norwegian University of Science and Technology NTNU, Research Institute of Sweden RISE, ENTSO-E, ETIP SNET, the Austrian Institute of Technology AIT, regulatory agencies, think-tanks and other organisations working on this topic.

7.3 ISGAN – GPFM Joint Side Event at Global Clean Energy Action Forum (GCEAF) in Pittsburgh, PA

ISGAN has organized a joint side event with Mission Innovation (MI) Green Powered Future Mission (GPFM) called "Boosting the Power System Transition: Innovation through ISGAN and GPFM" at the thirteenth Clean Energy Ministerial and seventh Mission Innovation meeting (CEM13/MI-7) in Pittsburgh, US in September 2022.

This event has showcased the collaboration between CEM's ISGAN and MI's GPFM to accelerate the development, demonstration, and application of innovative solutions that will unlock the pathway to flexible power systems.

While GPFM released its Action Plan 2022-2024 and announced two flagship projects that constitute its first sprint of activities, ISGAN presented its multifaceted work program that enables structured knowledge development and exchange across nations and domains on utility digitalization, transmission and distribution system interactions, and more.

This prestigious event saw prominent figures such as Young-Ghill Cheon, Deputy Minister for the Ministry of Trade, Industry, and Energy in the Republic of Korea, delivering remarks, benefitted from an IEA and IRENA keynotes, and included a very interesting panel discussion moderated by Mr. Abhay Bakre, Director General at the Bureau of Energy Efficiency (BEE), Ministry of Power, India.

The pinnacle of the collaboration was marked by the signature of the GPFM-ISGAN Memorandum of Understanding. This momentous occasion signaled a deepened collaboration between the two initiatives, fostering increased public-private sector engagement and a shared commitment to power system innovation. Witnessed by the Chair of the IEA Committee on Energy Research and Technology (CERT), this signature was a tangible testament to the mutual dedication towards driving the energy transition through joint efforts towards smarter, sustainable and reliable electricity networks worldwide.

Finally, the event was majestically closed by Maria Robinson, Director of the Grid Deployment Office at the US Department of Energy.

7.4. 8th ISGAN Annual Awards Ceremony

The event celebrated the 8th ISGAN Award of Excellence, which acknowledges outstanding achievements in the field of smart grid projects worldwide. The 2022 edition focused on two paramount themes – "EV Integration in Smart Grid" in collaboration with the Global Smart Energy Federation and "Smart Grid Workforce Development for an Inclusive Energy Transition" as part of the CEM Empowering People Initiative.

The Awards Ceremony gathered Ministers, Vice-Ministers, and high-level policymakers who lent their presence to announce the award winners. This prestigious event saw prominent figures such as Maria Robinson, Director of the Grid Deployment Office at the US Department of Energy, and Young-Ghill Cheon, Deputy Minister for the Ministry of Trade, Industry, and Energy in the Republic of Korea, delivering remarks. The contributions of Rob Jetten, honorable Minister for the Ministry of Climate and Energy Policy in the Netherlands, and Drew Leyburne, Assistant Deputy Minister for Energy Efficiency & Technology Sector at Natural Resources Canada, in announcing the award honorees further underscored the significance of the occasion.

The recipients of the 8th ISGAN Award of Excellence were as follows:

(Session 1) EV Integration in Smart Grid

Session 1: **EV Integration in Smart Grid**

- **Winner:** Smart Solar Charging Region Utrecht by STEDIN Netbeheer B.V., The Netherlands
- **Runner-Up:** VGI Core Component Development and V2G Demonstration using CCS Type 1 Standard by Korea Electric Power Corporation, Research Institute (KEPCO KEPRI)
- **Honorable Mention:** Peak Drive by Peak Power Inc., Canada

Session 2) SG Workforce Development for an Inclusive Energy Transition

Session 2: SG Workforce Development for an Inclusive Energy Transition

- **Winner:** Development of Smart Grid Ecosystem Project by India Smart Grid Forum
- **Runner-Up:** SEE (Smart Energy Education) Project by Korea Smart Grid Association
- **Honorable Mention:** TNB Reskilling Malaysia in Supporting AMI Workforce Development Program by Tenaga Nasional Berhad, Malaysia

Notably, the event also marked the renewal of the Memorandum of Understanding between ISGAN and the Global Smart Energy Federation (GSEF). The renewed agreement, extending until February 28, 2025, signifies the enduring commitment of both entities towards collaboration. Areas of cooperation outlined in the MOU encompass a spectrum of activities, from coordinating the ISGAN Award to organizing workshops and conferences that spotlight global successes in the energy domain.

The collaboration between ISGAN and GSEF, witnessed by high-level representatives and marked by the signing of significant agreements, exemplified the dedication of the international community towards driving the transition to a cleaner, smarter, and more sustainable energy future.

7.5. ISGAN & GPFM Joint Workshop

The CEM community came together for its first in-person meeting 6-8 April, 2022. After more than two years of virtual meetings, this week of events served as a strong positive reminder of the importance of international clean energy collaboration.

The objectives of the meeting were:

- Reuniting, strengthening, and energising our global CEM community through an interactive, insightful, and impactful hybrid meeting.
- Identifying and advancing practical actions that help achieve the CEM's mission, CEM3.0 strategy, and the goals of our CEM workstreams.
- Mobilising our global community to bring their boldest ambitions and best collective efforts to ensure that the 13th Clean Energy Ministerial is a huge success in Pittsburgh from 21-23 September.

A joint ISGAN and Mission Innovation Green Powered Future Misssion (GPFM) workshop of ISGAN and Mission Innovation Green Powered Future Mission (GPFM) took place on April 6th, 2022, in New Delhi, India during the CEM Senior Official's Meeting for the CEM13.

ISGAN and GPFM explored opportunities for joint activities on strategic topics of mutual interest in the field of Smart Grids, such as flexibility, resilience, and a consumer-centric vision for end users' empowerment and digitalized services.

7.6. India Smart Utility Week 2022

ISUW 2022 took place from 01 to 05 March, 2022. It is the main international Conference and Exhibition on Smart Energy and Mobility for Smarter Cities in India. The exhibition booths at ISUW 2022 offered interesting contributions from industry. ISUW 2022 brought together India's leading electricity, gas and water utilities, policy makers, regulators, investors and world's top-notch smart energy experts and researchers to discuss trends, share best practices and showcase next generation technologies and products in smart energy and smart cities domains. ISUW 2022 included plenaries, interactive workshops, keynotes, technical sessions and technical paper presentations. Bi-lateral smart grid workshops with European Countries, USA, Switzerland, Sweden, France, Canada took place.

For more details about ISUW 2022, please visit www.isuw.in.

7.7. ISGAN Virtual Learning Webinars 2022

Nº	date	title	Speaker(s)
01	2022-01-28	Contribution of the Osmose Project to the enhancement of the IEC61850 standard: Improvement of the engineering process and storage data modeling	Thomas Sterckx, Christoph Brunner, Camille Bloch, João Saragoça
02	2022-04-05	Demonstration of grid forming capabilities and synchronisation services	Carmen Cardozo , Mario Paolone, Markel Zubiaga
03	2022-04-07	Smart management of the grid: exploiting line temperature and load forecasts	Leonardo Petrocchi, Giuseppe Lisciandrello, Dario Ronzo, Davide Poli, Alfredo Vaccaro
04	2022-04-21	Demonstration of close-to-real-time cross border flexibility market	Gorazd Ažman, Andrea Bello, Miran Kavrečić, Dusan Vlaisavljevic, Marilena Lazzaro, Charles Payement
05	2022-06-07	Sustainable Peak Load Transformers	Angelo Baggini, Alberto Cracco, Bruno De Wachter, Phil Hopkinson, Fernando Nuño, Alan Sbravati
06	2022-06-13	Open exchange on TSO-DSO coordination activities, approaches, and solutions	Julia Strahlhoff, Jirapa Kamsamrong, Yvonne Ruwaida, Gwen Willeghems, Ferdinando Bosco, Matteo Troncia, Jose Pablo Chaves Avila
07	2022-07-05	Recommendations to pave the way for harmonised European flexibilities markets	Konstantinos Kotsalos, Sebastian Vogel, Gianluca Lipari
08	2022-09-29	Modeling and control of renewable energy power plants for participation in a Dynamic Virtual Power Plant (DVPP)	Stephan Kusche, Florian Pöschke, Horst Schulte

7.8. Webinar – Modeling and control of renewable energy power plants for participation in a Dynamic Virtual Power Plant (DVPP)

29 September 2022 - ISGAN Virtual Learning webinar on innovative models and control schemes of renewable energy plants

ISGAN Virtual Learning invited to this webinar that presented generic models and local control schemes of renewable energy plants for Dynamic Virtual Power Plant (DVPP) integration. This included different power plants, such as wind turbines, wind farms, PV systems, biogas, hydropower, and solar thermal power plants. The individual generating units were described in a unified model structure for local control design, simulation and the analysis of their dynamical characteristics. The derived models were intended for the integration into a higher-level control design of DVPPs.

Key messages

- Presentation of physically interpretable generic models of common renewable energy power plants (RPP) such as wind turbines, photovoltaics, biogas, hydropower, and solar thermal power plants in a unified modelling framework.
- Systematic justification and description of the internal controller structure of the primary (wind, PV, solar, biogas, hydro) and secondary (synchronous machine and power electronic converters) sides of the power plant types used in the DVPP.
- Straightforward performance verification of the internal control system by means of relevant test scenarios, such as active and reactive setpoint changes, variation of the energy source (wind, sun) of non-dispatchable plants, grid voltage drop, Phase angle step change.
- Calculation of the frequency characteristics of RPPs for DVPP design.
- Discussion of the planned experimental validation in the HTW lab.

7.9. Webinar – Recommendations to pave the way for harmonised European flexibilities markets

05 July 2022 - 13:00 CEST - ISGAN Virtual Learning webinar on the European R&I projects: INTERRFACE and CoordiNet findings

Key messages

- Flexibility can be an important tool for system operators to optimise the use of the grid while ensuring security of supply and accelerating the penetration of renewables in the electricty network.
- Improved coordination among energy stakeholders incuding TSOs, DSOs, FSPs (BSPs/BRPs) and consumers plays a fundamental role in achieving the uptake of market-based flexibility solutions as part of the energy transition.
- Through their extensive collaboration, the INTERRFACE and CoordiNet projects have defined a set of tools necessary to overcome the challenges faced by market stakeholders, and will present their joint recommendations for paving the way towards harmonised flexibility markets in Europe.

7.10. Webinar – Open exchange on TSO-DSO coordination activities, approaches, and solutions

13 June 2022 - 14:00 CEST - ISGAN Virtual Learning debate on the TSO-DSO coordination activities, approaches, and solutions

ISGAN Academy invited to this webinar to address the question of an optimal design of a cross-voltage level network operation, which takes into account an efficient use of flexibility resources. We invited experts from the international projects DA/RE, OneNet, Redispatch 3.0 and CoordiNet, to shed light and discuss the topic TSO-DSO-Consumer coordination in today's power system operation.

Key messages

- The presentation served to introduce current projects on the topic of TSO-DSO coordination.
- To show various ways of looking at the described topic, different needs for coordination were shown and various designs of coordination were discussed.
- Possible results from this were the identification of differences or similarities regarding the level at which optimization takes place, as well as different assumptions on market design, access to the coordinated resources and data management.

7.11. Webinar – Sustainable Peak Load Transformers

07 June 2022 - 14:30 CEST - ISGAN Virtual Learning panel debate on the evolution of peak load transformers.

Energy Transition and Circular Economy-related regulations are popping up around the world. Both energy efficiency and material efficiency are to be optimised. In electrical applications it is not always apparent how a trade-off between these goals can be avoided. The sustainable peak load concept for public distribution transformers does exactly that: it is beneficial to transformer energy efficiency as well as to material efficiency, with no need for compromise.
This webinar presented the concept, several case studies, a thorough transformer loading survey carried out in US, and a modelling exercise for the EU.

Key messages

- The total annual energy losses of a sustainable peak load unit are similar to those of a conventional unit. This is due to the fact that the average loading in public distribution networks is low, resulting in a higher relative importance of no-load losses compared to load losses.
- The material savings potential of sustainable peak load transformers is substantial, with reductions in total weight of 11 – 15%.
- The purchase cost of a sustainable peak load transformer is comparable to that of a conventional transformer if all other parameters are kept the same.

7.12. Webinar – Demonstration of close-to-real-time cross border flexibility market

21 April 2022 - 13:00 CEST - ISGAN Virtual Learning and the OSMOSE webinar concerning the experience on real-life demonstration activities.

The demonstration led by ELES in the OSMOSE project demonstrated the possibility of cross-border flexibility activation near-to-real time while complying with grid limitations.

The near real-time potential of flexibility of hydro producers was explored: new tools were developed and demonstrated live to estimate their remaining flexibility 15 minutes before delivery time.
The processes implemented resulted in a real cross-border activation thanks to a selection of bids every 5 minutes and an activation signal sent every 10 seconds.

The OSMOSE project aims to identify and develop the optimal mix of flexibilities for the European power system to enable the Energy Transition.

Key messages

- **Four large-scale demonstrators** led by Transmission System Operators explore the technical and economic feasibility of innovative flexibility services and providers, including: grid forming, multi-services by hybrid storage, near real-time cross border exchanges, and smart zonal energy management system.

7.13. Webinar – Smart management of the grid: exploiting line temperature and load forecasts

07 April 2022 - 13:00 CEST - ISGAN Virtual Learning and the OSMOSE project webinar concerning the experience of the Italian demonstration of OSMOSE project.

The Italian demonstration of OSMOSE project tested different kinds of flexibility solutions in a nine month long experimentation on a real HV grid portion, one of which was the flexibility from the grid itself. By exploiting accurate load and generation forecasts and cost effective Dynamic Thermal Rating solutions, a new Energy Management System was developed in order to detect and solve efficiently congestions in a three hour ahead horizon.

Speakers:

- Leonardo Petrocchi (Terna)
- Giuseppe Lisciandrello (Terna)
- Dario Ronzo (RSE)
- Davide Poli (ENSIEL)
- Alfredo Vaccaro (ENSIEL)

Key messages

- Capital-light investments and prediction algorithms can enhance existing assets exploitation, becoming an efficient add-on to standard infrastructural planning of the grid.

7.14. Webinar – Demonstration of grid forming capabilities and synchronisation services

05 April 2022 - 13:00 CEST - ISGAN Virtual Learning and the OSMOSE project webinar concerning off-the-shelf inverters interfacing energy storage systems.

The speakers demonstrated two activities part of the OSMOSE project, concerning off-the-shelf inverters interfacing energy storage systems with the power grid that can be turned into grid-forming units through suitable control upgrades in order to provide several services to the power system when it hosts massive amounts of inverter-based renewable/stochastic generation. This is achieved through to the provision of synchronisation services superposed to classic regulation ones.

Key messages

Within the context of service provision to future power systems hosting massive amounts of inverter-based renewable/stochastic generation, two demonstrations have shown that grid forming capability can be provided from off-the-shelf equipment. One demonstration is based on an existing MW-class BESS connected to the medium voltage grid of the EPFL campus, while the other was built for the OSMOSE project by Ingeteam and connected to the RTE network.

- Both demonstrations proved that grid forming capability can be provided without hardware oversizing, drawing out the most of existing equipment and therefore limiting the cost.
- A hybrid system showed that supercapacitors installed on the DC side can handle all fast transients induced by grid forming control, therefore smoothing the battery output power.
- The controls have been improved to behave properly in different grid conditions including harmonics and unbalanced conditions.
- Multiservices provision can be done including grid forming capability taking into account the unit's operational constraints.
- Accurate distribution-class PMUs can be used to assess the performance of grid forming vs grid following units.

7.15. Webinar – Contribution of the Osmose project to the enhancement of the IEC61850 standard: Improvement of the engineering process and storage data modeling

28 January 2022 - 13:00 - ISGAN Academy Webinar to discover the contribution of the Osmose project to the enhancement of the IEC61850 standard: Improvement of the engineering process and storage data modeling

IEC standards are essential to ensure a successful industrial uptake of innovative smart grid solutions, however further research and innovation are required in order to develop standardized descriptions of innovative components.

This webinar introduced the activities performed in the OSMOSE project regarding the engineering process and the functional tests performed on a dedicated demonstrator, based on the international standard IEC 61850. It addressed in particular the following aspects:

- Engineering process: configuration of the system, including devices from different manufacturers
- Results of functional tests: validation of the system configuration.

Key messages

- IEC standards are essential to ensure a successful industrial uptake of innovative smart grid solutions, however further research and innovation actions are required in order to develop standardized descriptions of innovative components.
- The proposed webinar described the activities performed by OSMOSE partners during the engineering process and the functional tests performed in WP7.1, and the contributions that these activities provided to the development of IEC 61850 standards.

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